Self-Gated Cine MRI for Clinical Wall Motion Abnormality Studies

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Introduction: Electrocardiogram (ECG)-gating uses an R-wave trigger to synchronize segmented cine data acquisition to the cardiac cycle. Disadvantages of ECG-gating are additional patient preparation time, susceptibility to RF and magnetic interference, and is ineffective in a significant percentage of patients[1]. More recently, self-gating techniques have been described which potentially eliminate the need for external physiological signal monitoring. Self-gated cine has recently shown to provide equivalent image quality to ECG gated cine in a limited sample of healthy volunteers[2] and patients[3]. However, the self-gating synchronization signal is largely dependent upon cardiac tissue motion and blood flow and therefore further clinical validation of the self-gating technique in wall motion abnormality studies was necessary. The purpose of this study was to demonstrate the clinical effectiveness of using self-gated cine sequence for qualitative wall motion abnormality assessments.

Methods: The self-gated sequence is a modified retrospectively gated TrueFISP cine sequence that acquires a short second echo after readout. The peak amplitude of the second echo varies in proportion to the average signal in the image, which is expected to change in synchrony with the cardiac cycle due to heart motion as well as through plane blood flow. An automated peak-detection algorithm is used to determine the trigger times.

Indications for cardiac MR were variable but primarily included patients undergoing myocardial viability and perfusion studies. Imaging was performed using a 1.5T Magnetom Avanto scanner (Siemens, Erlangen, Germany) with a 12-element body array coil. Breath-held acquisitions were performed using the following parameters: TR/TE = 3.4/1.6 ms, 350x263mm^2 FOV, 256x135 matrix, 60 ms temporal resolution, 6 mm slice thickness, 1.0 kHz/pixel BW. Multiple slices, including short and long-axis views, were obtained in 19 patients for a total of 50 measurements. ECG and self-gated image series were retrospectively reconstructed from each measurement, resulting in 100 total image series. For each image series, segmental wall motion was scored using the 16 segment model of the American Society of Echocardiography[4]. All 100 series were evaluated for wall motion (0-normal, 1-mild/moderate hypokinesia, 2-severe hypokinesia, 3-akinesia, 4-dyskinesia) and wall thickness (0-normal, 1-thinned) by an independent, blinded reviewer. ECG and self-gated data was compared using a two-tailed t-test with statistical significance set at α=0.05 level.

Results: Quantitative results showed that there was no statistically significant difference between cardiac wall motion and wall thickness scores between ECG-gated and self-gated acquisition (Table 1). The standard deviations were increased due to two images series whose difference between ECG and self gated score for mean wall motion and thickness was high (difference between wall motion - 11, 18, thickness- 3). Qualitative analysis showed no statistical difference between image quality by both gating techniques (p=0.05).

Conclusion: The self-gated cine TrueFISP sequence, using a conventional Cartesian sampling scheme, showed no difference from ECG-gated sequences in quantifying wall motion and thickness in a sample of patients referred for clinical cardiac MR. This promising self-gating technique has many advantages to ECG-gating and will continue to be evaluated in a larger population of patients.

Table 1: Results of data analysis

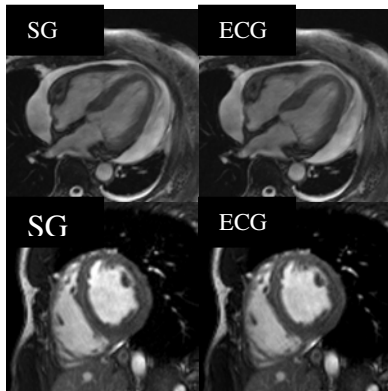|	Mean Wall Motion (±SD)	Mean Wall thickness (±SD)
Difference between ECG and SG Score	0.24 (±3.44) p value = 0.624	0.04 (±0.49) p value = 0.569

Figure 1: Long axis – Self and ECG gated images of patient with clinically evaluated LVEF of 47%, Short axis- Self and ECG gated images of a patient with LVEF of 63%

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